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Design and Characterization of a Low Defect Density Mo/Si Deposition System for the Fabrication of EUVL Reticle Blanks*

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Reticles for extreme ultraviolet lithography (EUVL) consist of a high reflectance multilayer (ML) coated substrate (the reticle blank) that is overcoated with a patterned absorber layer to form a reflective mask. Any reflectance variation in the reticle constitutes a potential reticle defect. At present there are no strategies for repairing defective regions of the ML coating. Consequently there is considerable interest in developing a deposition technology capable of producing virtually defect free high reflectance Mo/Si MLs. Specifications for the reticle blank require a defect density of less than 0.06/cm^2 at 0.05 μm diameter or greater over reticle dimensions of 13x22 cm at a magnification M=1/5[1]. In many respects, reticle fabrication requires merging highly developed, disparate technologies - the fabrication of a high reflectance low defect density ML optical coating to standards normally associated with semiconductor manufacture.

The design and characterization of a low defect density Mo/Si ML deposition system commissioned specifically for EUVL reticle blank fabrication is reported. A filamentless, inductively coupled, low frequency rf ion source with focusing optics[2] is used to sequentially sputter elemental Mo and Si targets to form the ML. Ar is used as the sputtering gas. System features include fully load-locked operation, single wafer transfer from cassette to the deposition chamber and standard mechanical interface (SMIF) handling of the cassette. Sample introduction and transfer occurs in a class 1 minienvironment. 150 mm diameter Si wafers are employed as substrates, a concession to the ready availability of appropriately clean substrates and compatibility with standard semiconductor diagnostic tools. Defect characterization is undertaken with a Surfscan 6420 which can detect 0.13μm diameter particulates on the ML coated wafer surface at greater than 90% efficiency[3]. This instrument is also configured for SMIF handling of cassettes and is housed in its own class 1 minienvironment, adjacent to the deposition system.

[1] The National Technology Roadmap for Semiconductors, Semiconductor Industry Association (1994).
[2] Veeco Instruments RIM 210 ion source
[3] Tencor Instruments, Santa Clara, Ca

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